NASA Dryden Status

Aerospace Control & Guidance Sub-committee
Meeting 104
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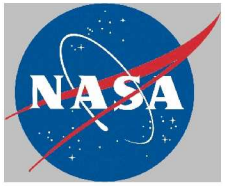


IRAC F-18 #853 Testbed

- Dedicated Ghz processor for experiment
- Shell & process for Simulink autocode (or c-code)
- Can control commands to:
  - All aero surfaces (except speed brake)
  - All pilot inputs
  - Both engine throttles independently
- Limit checks done by Class A software in RFCS
- Potential for Class A experiment (dual ARTS IV or in quad RFCS) – take to landing?
- Tons of research instrumentation parameters (mostly related to structures)
- Simulated failure of multiple control surfaces

NASA Dryden Flight Research Center Photo Collection
http://www.dfrc.nasa.gov/Gallery/Photo/index.html
NASA Photo: EC04–0361–16 Date: December 15, 2004 Photo By: Carla Thomas

NASA's flexible–wing F/A–18 maneuvers through a test point during the second phase of the NASA/Air Force Active Aeroelastic Wing flight research program.

IRAC Full Scale Flight Experiment Peer Review Selection Process

- Completed workshop at AIAA GNC in Chicago
  - Very good feedback and discussion
- Decision to emphasize three adaptive system Focus Areas:
  - 1 - Pilot Interaction
  - 2 - Simplified System
    - Analyzable
    - V&V-able
  - 3 - Structural Interaction
    - Static structures – fiber optic deflection measurement system
    - Aero-servo-elasticity – adaptive feedback to eliminate structural modes from sensed motion

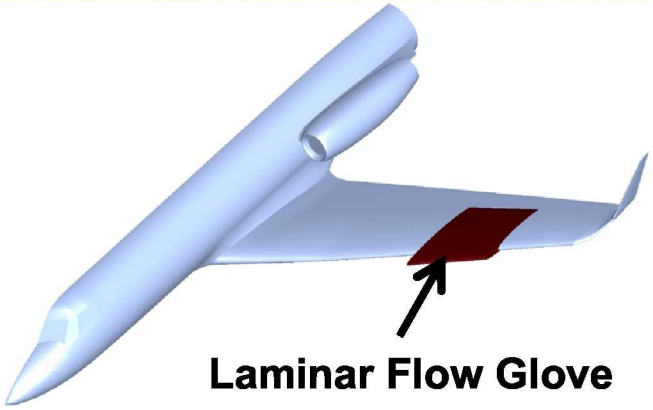
IRAC F-18 #853 Testbed - Current Status

- Completed Hardware-in-the-loop testing (August)
  - Aircraft is currently flying non-research flights
    - First flight of new hardware March 2010

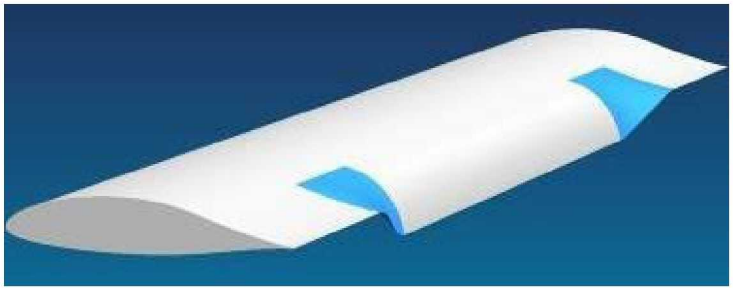
- Evaluating simplified adaptive control approaches
  - Dynamic Inversion Baseline
  - Simplified MRAC
  - Benefit vs. complexity trade studies on extensions to basic MRAC
- Investigating ways for pilot to control learning rates
- Planning to fly cross-coupling handling qualities metric development test with AFFTC test pilot school
- Future planned work
  - Adaptive controller implemented in redundant system

NASA G-III Research Aircraft

- NASA DFRC is acquiring a Gulfstream III (G-III) to serve as a flying testbed for aeronautics experiments
- The aircraft will be instrumented and modified to accommodate a range of flight test-experiments
- Laminar Flow Glove
  - NASA's ERA program is funding a flight-test of a wing glove with a natural laminar airflow airfoil. Discrete Roughness Elements (DRE)s will be placed on the glove for passive laminar flow control. Texas A&M and Dryden will be developing the glove.
- Adaptive Compliant Trailing Edge (ACTE)
  - AFRL is funding development and flight test of an adaptive, compliant flap. The port inboard flap of the G-III will be replaced with a compliant design. The flight test will examine ACTE suitability as a lift control device (flap), control surface (ailerons), and trim device (trim tabs).
- Aircraft acquisition planned for early CY 2010.



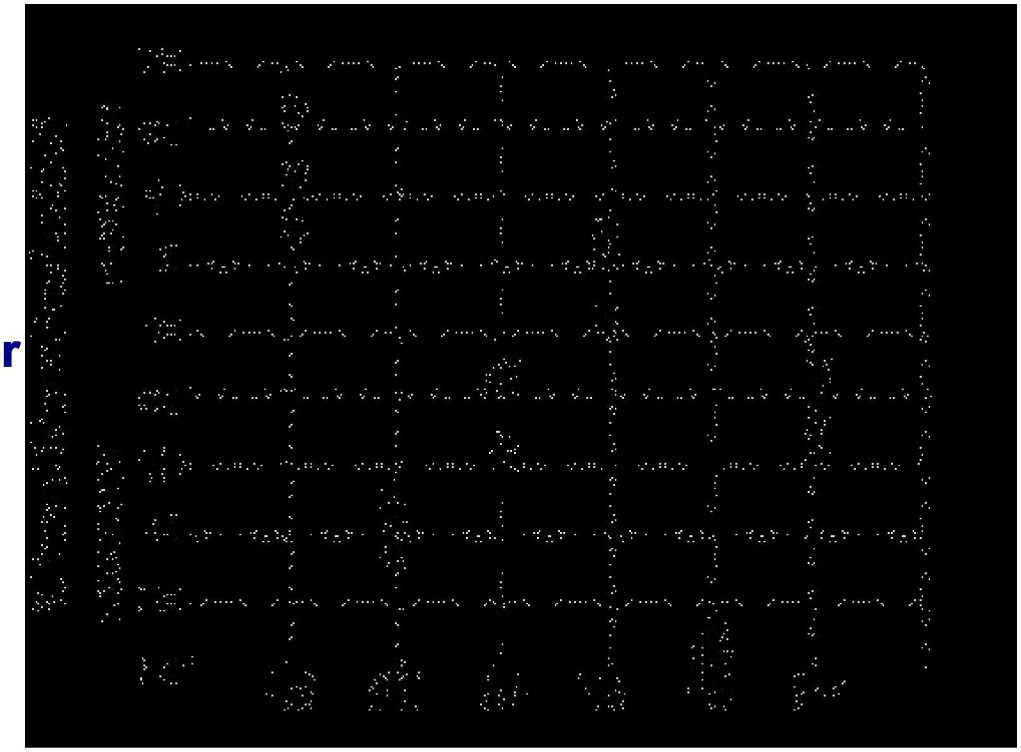
Laminar Flow Glove



Adaptive Compliant Trailing Edge

X-48B Blended Wing Body

- 66 flights completed
  - Slats extended and slats retracted stall onset has been characterized
  - Flight results providing data for aerodynamic model and simulation updates



- Peak seeking control to optimize in-flight drag reduction in 2010
- X-48C completed wind tunnel testing

SOFIA

- Stratospheric Observatory for Infrared Astronomy
  - 2.5 m diameter German built infrared telescope
  - Open port cavity
    - » ~24°-57° viewable elevation range
  - Platform is Boeing 747 SP
    - » Capable of 6+ hours of observation time
- Open door flights scheduled fall 2009
  - Envelope clearance with a cavity acoustics focus
  - Basic telescope systems characterization
  - Goal for first limited science missions by the end of 2009
  - Autopilot interface development to support science mission navigation requirements is ongoing

Orion CEV Launch Abort Systems Tests

- Dryden is leading the test activities for the Launch abort systems test. Tests will be conducted at White Sands, NM
- Pad Abort 1 (PA-1): Tests the basic functionality of the launch abort system from the pad in its preliminary design configuration.
- ~~Ascent Abort 1 (AA-1): Tests the ability of the launch abort system to function while the spacecraft is traveling through the period of maximum dynamic pressure.~~
  - Cancelled due to scheduling conflicts –
  - AA-1 & AA-2 within 3 months of each other
- Ascent Abort 2 (AA-2): Tests the ability of the launch abort system to function as the spacecraft approaches the region of maximum drag.
- Pad Abort 2 (PA-2): Continues to refine the data collected on PA-1 on a more production-like crew module.
- Ascent Abort 3 (AA-3): Tests the ability of the launch abort system to perform in the event it is tumbling due to a loss of control of the launch vehicle.

Current activities

- **Hardware testing and integration of the PA-1 crew module at White Sands, NM**
- **Preparation for PA-1 Mission Review**
- **Planning for future test flights**

To Fly What Others Imagine …